What is Claimed Is:

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1.   In an industrial equipment network for interconnecting a plurality of devices, apparatus

for permitting an associated SCADA system to be self-configuring, comprises:

        a plurality of controllers dedicated to each one of said plurality of devices,

respectively, for providing each with control and data functions for interacting with other of

the devices in the equipment network, and other systems, and programming each controller to

provide the interconnection of its associated device with other ones of said plurality of

devices;

        a computer network;

        means connected between said computer network and said plurality of controllers,

respectively, for transferring data and/or control signals between individual ones of said

plurality of controllers and said computer network at given times; and

        auto-discovery means for permitting said SCADA system to both self-configure itself

relative to devices in said industrial equipment network, and to be updated relative to changes

in the configuration of said industrial equipment, and associated devices or equipment therein,

including discovering new or changed devices via communication over said computer

network.

2.   The apparatus of Claim 1, wherein said plurality of controllers are each provided by a

programmable logic controller (PLC).

1   3.   The apparatus of Claim 1, wherein said transfer means is selected from the group

2   consisting of a router, and switch.

1   4.   The apparatus of Claim 1, wherein said computer network consists of a local area

2   network (LAN).

1   5.   The apparatus of Claim 1, wherein said auto-discovery means includes:

2   broadcast means for operating a controller of a given device, that has either changed its

3   configuration or is new to said industrial equipment network, to broadcast over said computer

4   network an auto-discovery protocol; and

5   server means included in said SCADA system responsive to an auto-discovery

6   protocol from said given device, for interrogating said controller of said given device to access

7   sufficient data to permit said SCADA system to update its configuration for the given device

8   itself and within the industrial equipment network.

1   6.   The apparatus of Claim 1, wherein said auto-discovery means includes:

2   server means included in said SCADA system and connected to said computer

3   network, for in a first mode of operation periodically polling respective controllers of all of

4   said plurality of devices in said industrial equipment network for any respective changes in

5   configuration and identification of new ones of said plurality of devices, and in a second mode

6   of operation individually interrogating each responding one of said plurality of devices for

7   new data to permit said SCADA system to update its configuration information.

1   7.   A method for permitting a Supervisory Control and Data Acquisition system

2   (SCADA) to automatically diagram the interconnection and interaction, and changes thereto,

3   between a plurality of pieces of industrial equipment and/or a plurality of devices that may be

4   connected to one another and to a data network, said method comprising:

5   establishing a network over which a plurality of said plurality of pieces of industrial

6   equipment and/or devices can selectively communicate with one another and with a SCADA

7   system;

8   connecting different ones of said plurality of pieces of industrial equipment and/or

9   devices each to either a common controller, or each to individual dedicated controllers,

10   respectively, or each to a plurality of controllers, or some combination thereof; and

11   programming each controller for controlling and identifying its associated piece of

12   industrial equipment and or device, and for sending data representative of the interconnection

13   and interaction thereof with other ones of said plurality of pieces of industrial equipment

14   and/or devices, both to the latter equipment and/or devices, and to said SCADA system over

15   said data network.

1   8.   The method of Claim 7, further including the steps of:

2   assigning a unique IP address to each one of said plurality of pieces of industrial

3   equipment and/or devices upon their request as they are connected to the network;

4   broadcasting onto the data network an auto-discovery protocol including the associated

5   IP address from each piece of equipment or device when it is added to the network, or

6   thereafter when a change is made to its interconnections and interaction with other of said

7   plurality of pieces of equipment, and/or devices;

8   acknowledging via a server of said SCADA system the receipt of an auto-discovery

9   request;

10   transferring to said server a description of the associated piece of equipment or device,

11   to permit said SCADA system to configure monitoring;

12   operating said SCADA system to automatically monitor either by polling or receiving

13   broadcasts from said piece of equipment or device; and

14   programming said SCADA system to automatically update and include the associated

15   piece of equipment or device in a diagram identifying and showing each, and their interaction

16   with other ones of said plurality of pieces of equipment and/or devices.

1   9.   The method of Claim 8, wherein an extensible mark-up language (XML) is used for

2   describing or providing information for each one of said plurality of pieces of industrial

3   equipment or devices, respectively.

1   10.   The method of Claim 7, further including the steps of:

2   assigning a unique IP address to each one of said plurality of pieces of industrial

3   equipment and/or devices upon their request as they are connected to the network;

4   programming a server in said SCADA system to periodically poll said plurality of

5   pieces of industrial equipment and/or devices;

6   operating a controller of each polled device or piece of industrial equipment to respond

7   to a discovery request from said server by providing a description thereof; and

8   operating said server to use the description to configure monitoring of the associated

9   device or piece of industrial equipment, whereafter device or equipment monitoring begins.

1   11.   The method of Claim 10, wherein an extensible mark-up language (XML) is used by

2   an associated controller to describe each polled device or piece of industrial equipment.

1   12.   The method of Claim 7, further including the steps of:

2   configuring each dedicated controller for having its associated device or piece of

3   industrial equipment interconnect and interact with selected other ones of said plurality of

4   pieces of industrial equipment and/or devices;

5   operating each controller for connecting its associated device or piece of equipment to

6   said network;

7   operating each controller and a server in said SCADA system for providing auto-

8   discovery by the latter of each device and/or piece of equipment;

9   operating each controller to respond to a request from said server to provide both a

10   description of the associated device and/or piece of equipment, and its interaction with other

11   devices and/or pieces of equipment;

12   operating said server, in response to the description and interaction of said plurality of

13   devices and/or pieces of equipment, to initially establish and thereafter update a database and

14   a user interface of said SCADA system; and

15   operating said server to begin monitoring the associated device.

1   13.   The method of Claim 12, wherein an extensible mark-up language (XML) is used to

2   describe each device and/or piece of equipment, and their respective interaction.

1 14. The method of Claim 12, further including in said step of operating each controller and

2 a server in said SCADA system for providing auto-discovery, the steps of:

3 measuring the time for said server to respond to a controller of a device or piece of

4 equipment awaiting a reply; and

5 indicating a network fault, and interrupting further SCADA system processing for the

6 associated device or piece of equipment, if no reply is received within a predetermined period

7 of time.

1 15. The method of Claim 7, further including the steps of:

2 configuring each dedicated controller for having its associated device or piece of

3 industrial equipment interconnect and interact with selected other ones of said plurality of

4 pieces of industrial equipment and/or devices;

5 operating each controller for connecting its associated device or piece of equipment to

6 said network;

7 operating each controller to request a reply from a respective controller of each

8 selected one of other of said plurality of devices and/or pieces of equipment;

9 operating each controller to wait for a reply; and

10 operating a requesting controller in response to a reply from another controller to

11 provide the latter with data for updating a database of its associated device or piece of

12 equipment with identification and interconnection data associated with the device or piece of

13 equipment of the requesting controller.

1   16   The method of Claim 15, wherein said step of operating each controller to wait for a

2   reply further includes the steps of:

3   measuring the time from making a request for reply to the receipt of a reply; and

4   indicating a network fault and interrupting further processing if no reply is received

5   within a predetermined period of time.

1   17.   The method of Claim 12, further including the steps of:

2   operating each controller to request a reply from a respective controller of each

3   selected one of other of said plurality of devices and/or pieces of equipment;

4   operating each controller to wait for a reply; and

5   operating a requesting controller in response to a reply from another controller to

6   provide the latter with data for updating a database of its associated device or piece of

7   equipment with identification and interconnection data associated with the device or piece of

8   equipment of the requesting controller.

1   18.   The method of Claim 17, wherein said step of operating each controller to request

2   contact from a respective controller of each one of said plurality of devices and/or pieces of

3   equipment, further includes the steps of:

4   measuring the time from making a request for reply to the receipt of a reply; and

5   indicating a network fault and interrupting further processing if no reply is received

6   within a predetermined period of time.

1   19.   The method of Claim 12, wherein said step of operating each controller and a server in

2   said SCADA system for providing auto-discovery by the latter of each device and/or piece of

3   equipment, further includes the steps of:

4   assigning a unique IP address to each one of said plurality of pieces of industrial

5   equipment and/or devices upon their request as they are connected to the network;

6   broadcasting onto the data network an auto-discovery protocol including the associated

7   IP address from each piece of equipment or device when it is added to the network, or

8   thereafter when a change is made to its interconnections and interaction with other of said

9   plurality of pieces of equipment, and/or devices;

10   acknowledging via a server of said SCADA system the receipt of an auto-discovery

11   request;

12   requesting via said server a description of the associated piece of equipment or device,

13   to permit said SCADA system to configure monitoring;

14   operating said SCADA system to automatically monitor said piece of equipment or

15   device; and

16   programming said SCADA system to automatically update and include the associated

17   piece of equipment or device in a diagram identifying and showing each, and their interaction

18   with other ones of said plurality of pieces of equipment and/or devices.

1   20.   The method of Claim 12, wherein said step of operating each controller and a server in

2   said SCADA system for providing auto-discovery by the latter of each device and/or piece of

3   equipment, further includes the steps of:

4   assigning a unique IP address to each one of said plurality of pieces of industrial

5   equipment and/or devices upon their request as they are connected to the network;

6   programming a server in said SCADA system to periodically broadcast a discovery

7   request poll to said plurality of pieces of industrial equipment and/or devices;

8   operating a controller of each polled device or piece of industrial equipment to respond

9   to a discovery request from said server by providing a description thereof; and

10   operating said server to use the description to configure monitoring of the associated

11 device or piece of industrial equipment, whereafter device or equipment monitoring begins.